Aerial view of the reinforced concrete courthouse (upper left) at Cameron, La., taken four days after Hurricane Audrey had devastated the area on June 27. Designed as a storm refuge, the courthouse came through unscathed in contrast to the surrounding destruction. From 600 to 1,000 people escaped death by taking shelter there. Original cost of the building, completed in 1938, was $125,000, certainly an investment that paid off.

# Concrete Courthouse Saves Hundreds From Hurricane

OUT OF THE GULF OF MEXICO on the morning of June 27 roared the first hurricane of the season, striking with winds up to 110 miles an hour and causing a 10-feet tidal wave to sweep inland. Several whole villages along the coast were completely demolished, people and animals were swept away and drowned, the countryside inundated. News reports suddenly focused the attention of the nation on the little town of Cameron, Louisiana. As rescue workers brought out survivors, a dramatic story emerged of the part played by the parish courthouse there. Originally built in 1937, this building was designed of reinforced concrete especially to provide the town with a place of refuge during hurricanes, which are frequent along this section of the coast. Exact figures are not available, but between 600 and 1,000 people escaped death last month by taking shelter there.

One of the tragic aspects of the storm was that many people lost their lives unnecessarily. Storm warnings had been issued 48 hours before. Many of those saved came to the courthouse at the last minute, after the full force of the hurricane had hit. Others who were in the courthouse at the time of the first major blow went out afterward and were unable to return, because of the tidal wave which followed.

Rescue workers reached the courthouse 24 hours after the storm first struck. As the only habitable building in the area, it became the center of rescue and clean-up operations. Various parts of the building were used for sleeping quarters, canteen, Red Cross medical aid station, and communications center.

When photographers flew in on Monday following Thursday's storm, the courthouse stood undamaged in the midst of scattered timbers, broken furniture, twisted buildings, oil tanks, and washed-up fishing vessels. Although water had filled the basement and risen to the top of the 7-foot-high front steps, the base of the building was sound. Wooden buildings in the town, if not demolished by the wind, had in many cases been swept off their foundations or overturned by the tidal wave.

The remarkable way in which the courthouse withstood both wind and water is striking proof of the importance of storm-resistant design in areas exposed to hurricanes or tornadoes. When construction of the building was planned, careful consideration was given to making it resistant to fire, hurricane and tidal wave. Wide footings for the courthouse were extended down through sand and shell to hard clay. The reinforced concrete walls were 12 inches thick, buttressed by battered pylons and braced by concrete floors and roof. The resulting building was permanent and strong, and hundreds of people are alive today as a direct result. END

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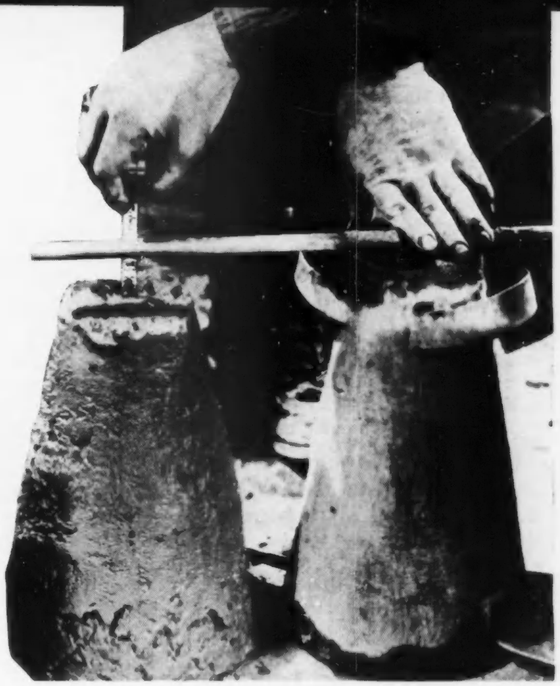
The uniformity of the consistency of the batch was measured by slump tests. These were made by filling a truncated cone with the freshly mixed concrete, then withdrawing it and measuring the number of inches the concrete has subsided from the original height.



**Here's new light on the performance of ready-mixed concrete trucks under field conditions — with special reference to the low-slump, harsh mixes required in pavement work.**

# Truck Mixers Undergo Performance Tests

AN ADVERTISEMENT in one of our recent issues made the statement that there's a lot back of the rating plates on the truck mixers that deliver ready mixed concrete to thousands of important construction jobs every day. Among other things the advertisement talked about research that has resulted in important improvements in truck mixer performance and in the quality of concrete.

An example of just such research has come to our attention in connection with the issuance of a progress report on two years of testing the performance of truck mixers. Conducted by the Plainfield Division of Worthington Corporation, an important manufacturer of such equipment, the major objective of the tests is to provide more reliable data on truck mixer performance on the low-slump harsh batches required for concrete used in paving work.

Thus the project represents a recognition that increasing amounts of ready-mixed concrete are being used for pavements. The investigators hope to arm ready-mix producers with firm data which may be used as an accurate guide for producing concretes which will readily meet the stiff specifications which are being written today.

The immediate objective was to study the performance of truck mixers of the inclined-axis type when tested under field conditions. The effects of nine different batching sequences on the uniformity of both air-entrained and non air-entrained concrete were investigated. These were split loading, ribbon loading, and combinations of the two.

In some batches water was added at the batching plant and in others it was added from the water tank of the truck mixer at the job site. Tests were made with mixers loaded to their 4½-cubic yard normal rated capacity, and parallel tests were made for loads of 5 cubic yards which these mixers are guaranteed to handle. The number of revolutions of the mixer drum was varied in steps from 50 to 150, and the time required for loading, discharging and mixing were all measured.

Some of the tentative conclusions indicated by the test findings are of great interest to both producers and users of ready-mixed concrete. For example, the effect of consistency on the time of discharge is of vast importance to both groups. The tests indicate that time of discharge is fairly constant for slumps greater than 2 inches, but that it goes up quite rapidly for slumps less than 2 inches. (See graph.) The time of discharge for a concrete of 1-inch slump is about double that for a 2-inch slump concrete, but is less than 3 minutes per cubic yard.

Some other significant conclusions:

Good uniformity, as measured by variations in relative strength, was obtained when the water was introduced into the mixer at the batching plant. This was true for both non air-entrained and air-entrained concrete, for ribbon and split loading, for the amounts of mixing investigated, and for 5-cubic yard loads as well as 4½-cubic yard loads.

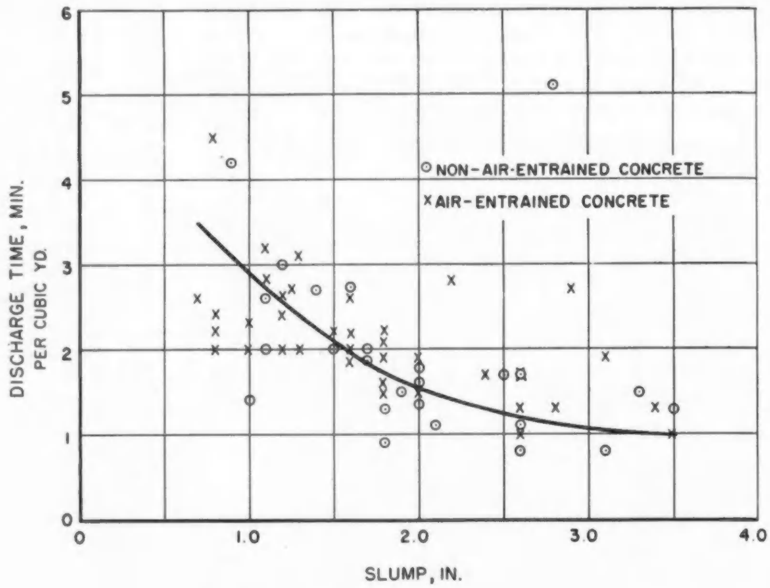
The different methods of measuring uniformity indicated that the minimum of 50 revolutions of the drum

are, except for certain slurry and split loading conditions, sufficient to produce the uniformity desired.

Under the poorest of the loading conditions represented by these tests, improvement in uniformity of relative strength was obtained by increasing the number of revolutions of the mixer drum.

The uniformity of consistency as measured by the slump tests shows that a paving type concrete of low slump (less than 2 inches) can be produced readily in truck mixers. The relationship between slump and discharge time shows that even low slump concretes can be discharged rapidly without segregation of the ingredients.

Lack of uniformity in the grading of the ingredients appeared to occur only when slurry mixes were employed. Increasing the amount of mixing improved the uniformity. Some results showed that for other than the slurry mixes there was a tendency for the 150 revolutions to cause some slight segregation.




RELATION BETWEEN CONSISTENCY OF CONCRETE AND DISCHARGE TIME

In this investigation, the mixers performed as well when mixing a 5-cubic yard as for 4½-cubic yard loads; the one exception was the case of split loading where water was added at the job site.

The study also dealt with the effect of the rate of mixing on the performance of truck mixers, but no information on this point has been released. As soon as the data are released for publication, CONCRETE CONSTRUCTION will make them available to its readers. END

**Here samples of concrete are being taken from various portions of a batch of concrete as it is discharged from a truck mixer.**

The combination of the stakes and braces provides the speed of erection as well as the rigidity and accuracy of a steel form. The dual purpose brace can be used very effectively where mud sills are required.

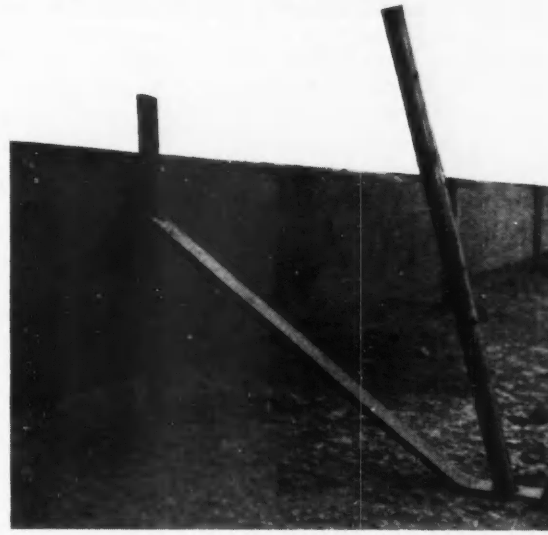


Photo courtesy Dee Concrete Products Co.

# Steel Stakes, Spreader Bars, and Braces

**The cost savings of partial mechanization can be brought to poured concrete driveways, sidewalks, footings, and curbs.**

CONTRACTORS ENGAGED in doing concrete construction work are realizing important savings these days through the replacement of such one-use facilities as wooden stakes and form braces with reuseable metal accessories. Metal form accessories such as stakes, braces and spreaders are gaining rapid acceptance because they bring much of the economy of prefabricated forms to such categories of concrete work as driveways, sidewalks, footings, curbs and gutters, patios and garage floors.

The use of such accessories fights the rising cost spiral on two fronts—by saving the materials themselves and by making it possible to effect substantial savings in labor costs. Experienced contractors say that the items are virtually indestructible, that they result generally in better, more accurate workmanship. They point out, in contrast, that wooden stakes and braces often have to be discarded after one or two uses, that in any case a labor investment is required to prepare them for reuse, and that they leave much to be desired from the standpoint of accuracy.

In addition to these direct savings, metal form accessories fight rising costs in several indirect ways. Their use accomplishes on most jobs about a 50 percent reduction in the number of nails used. The result is fewer nails to buy, a measureable saving in labor required to handle, drive and remove nails, and a general speed-up of the whole operation of getting form lumber and accessories ready for reuse.

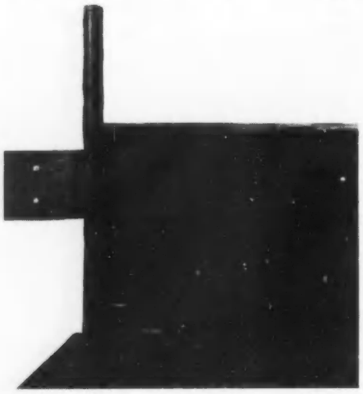
There is also an important safety dividend that should appeal to contractors who are aware of the increasing accident toll on all types of construction projects. The hammer and splinter injuries so prevalent in setting wooden stakes and braces just don't occur when these facilities are replaced with metal accessories specifically designed for the work to be done. Job housekeeping improves, too, and accidents are reduced when the hazards of discarded lumber and nails are eliminated.

Another factor that appeals strongly to many contractors is that there is no

FILE FORMING

need to reeducate workers for the switch from wooden stakes and braces to metal units, since both types of equipment operate on the same principle. The adaptability of the metal units encourages the wider use of standard form boards, and makes it possible to maintain job schedules even under the most adverse conditions.

Pointed metal stakes, made of solid steel rod, can be used for a variety of purposes — as form stakes, braces, markers for striking grades, screed bar supports, and similar uses. Most types



**Joiner plates, attached readily to steel stakes by means of sleeves, provide excellent alignment for form boards.**

provide for nailing form boards at any position by means of a dozen nail holes spaced on 1-inch centers. Stakes of this type drive straight down into small, clean holes which provide maximum support. They make possible a fast and truly vertical drive, and form boards can be set quickly by means of only one or two double-headed nails.

Metal spreader bars, made of steel angles and especially designed for footing forms, are also gaining wide acceptance among cost-conscious contractors. Round holes provided in these units become the locater holes for standard footing widths.

Here is how spreader bars are used in combination with steel stakes: The form board is set up on one side of the footing to be poured and staked down with steel stakes; then spreader bars are placed over the stakes for the width of the footing to be poured; to complete the forming, the bar is swung across, nailed to the form board on the opposite side of the footing, and a stake is driven through the slot. After the concrete is poured the nail is removed, the bar swung free, and the footing is left clear for the placement of inserts, bolts or construction joint material.

Steel braces, or kickers as they are more commonly known, are heavy steel bars with a slot in the top and a hole in the bottom. They are designed to support the form in normal use as well as where mud sills are required. The setting procedure is quite simple and takes only a moment: The top of the brace is set against the stake that holds the form board, and a stake is driven in the back hole; final adjustment is achieved by raising or lowering the kicker until alignment is obtained, and then the kicker is nailed to the form board with only one nail. Since only one nail must be taken out, and there is nothing to clean up, the removal of forms set in this fashion is extremely rapid. Advocates of the system say that it achieves both the rigidity and accuracy of steel forms.

Manufacturers have recognized the need for other hardware items to increase the efficiency of the basic accessories described above. Pullers have been developed to facilitate the removal of steel stakes; they make it

**Accurate wall widths without measuring, square corners, faster installation and removal all substantially cut forming costs on footings. These stakes and spreader bars are especially advantageous in sand or fill as this photo indicates.**

possible to pull stakes with a single stroke, regardless of whether the stake is above or below the form board. Joiner plates, welded to stakes or sleeves, can be used at form joints to keep them level and to dispense with the need for two stakes. Screed pads, posts and brackets have also been developed for use in multi-story buildings or wherever large areas of concrete are to be poured.

So certain are the manufacturers of this type of equipment that metal form accessories pay off, that several now offer rental-purchase options so that contractors may satisfy themselves before making a large investment. As part of the broad effort to keep poured concrete construction within the budget of even the modest building projects, metal form accessories are making an important contribution to the whole field of poured concrete. END

**Sidewalk costs come down measurably when this simple forming operation is speeded up with steel stakes.**

**Here you see the old method of supporting forms for flat work or slabs. Note the closely spaced wooden stakes and braces. Many nails must be driven and removed.**

# A Quick Method for Determining Cement Content of Fresh Concrete

BY ROBERT E. TOBIN
*Portland Cement Association*

**EDITOR'S NOTE**

**We have just learned that the New York City Housing Authority has temporarily suspended use of the Willis-Hime test for cement content due to the illness of two operators who had been performing the test. The cause is believed to be failure to provide adequate ventilation for the carbon tetrabromide used in the process. A substitute material for this troublesome ingredient is common fuel oil, which is much cheaper, readily available, and seems to work equally well without having any of the toxic effects of the carbon tetrabromide.**

THE PRODUCTION OF QUALITY CONCRETE is the pride of the ready-mixed concrete industry. All of the ingredients in a concrete mixture, the sand, the gravel, the cement and the water, are carefully produced and thoroughly tested to insure that they conform to applicable specifications. When these ingredients are properly proportioned, placed, finished and cured, it is possible to predict with certainty the final properties of the hardened concrete. Even though these ingredients are all pre-tested, the manner or proportions in which they are put together is the determining factor on this final quality. To insure that this product of the ready mixed concrete industry will meet these high quality requirements, a new test has been developed to evaluate the amount of cement in a concrete mix.

Several attempts have been made to devise a method of determining the cement content of fresh concrete. A few years ago a new concept of such a test was originated by R. A. Willis, an engineer in the St. Louis District Office of the Portland Cement Association. To separate the cement from the aggregate, Willis employed a heavy liquid in which the aggregate would float but the cement being heavier would settle to the bottom. The application of this concept to a practical test method was later made by W. G. Hime, Research Chemist in the Research and Development Laboratory of the Portland Cement Association in Chicago. The test is now known as the Willis-Hime method.

This paper was originally presented at the 27th annual convention of the National Ready Mixed Concrete Association at Los Angeles, California, February 14, 1957.

**Fig. 1—Large beaker, 30 mesh wire basket, graduates, centrifuge tubes, beam balance, hydrometer and miscellaneous small equipment.**

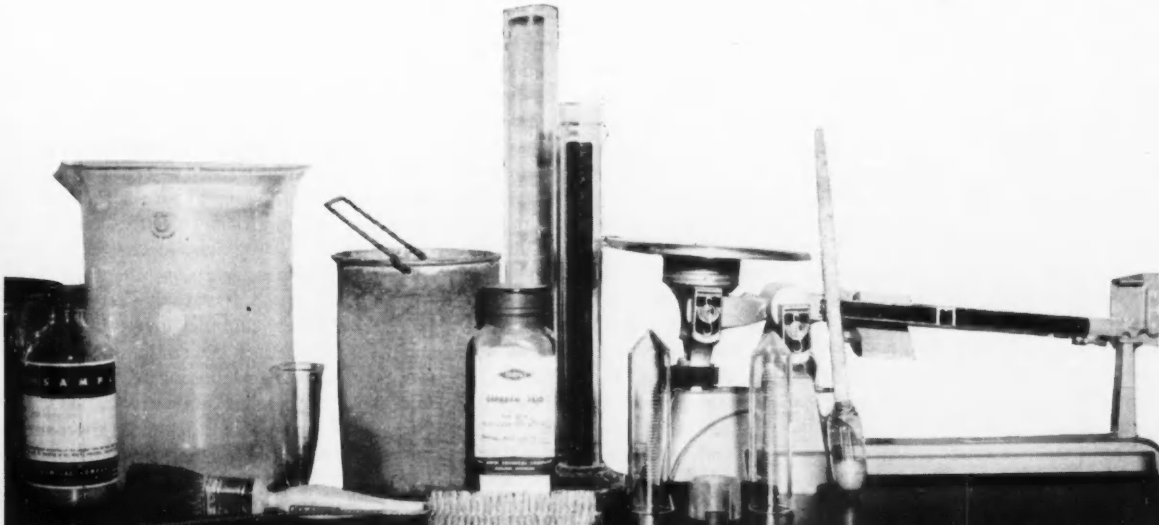


Fig. 2—Centrifuge, drying pan, portable stove and other small items of apparatus.

In performing the test a sample of fresh concrete is secured on the job in much the same manner as for making a test cylinder. The size of the sample should be around four to five pounds but its exact weight should be determined on a beam balance or scale. This sample is then washed through a No. 30 mesh wire basket (see Fig. 1) by immersing the wire mesh basket in a container of water. The oversize sand and rock is discarded and the fine sand and cement which pass through the basket rapidly settle in the container. The excess wash water is poured off and the fine sand and cement is transferred to a pan for drying (see Fig. 2).

After the fine sand and cement mixture has been thoroughly dried, which requires about 30 minutes, the dry material is then carefully weighed. Two identical samples of 25 grams each are selected from this dry material and placed in individual centrifuge tubes. The tubes are next filled with the heavy liquid (an acetylene tetra-bromide solution) which weighs about three times as much as water. The tubes are rotated in a centrifuge for a prescribed period which causes the cement to settle to the bottom and the fine sand being lighter floats to the surface of the heavy liquid.

The centrifuge tubes are marked or graduated so that the volume of cement which settles in each tube can be readily determined. This volume of cement can then be compared with a chart or graph (see Fig. 3), previously prepared from known mixtures, to determine the number of sacks of cement per cubic yard in the original sample.

About a year ago it was decided that this test should be given a trial run in various places throughout the country on an experimental basis. These trial runs were to check the validity of the test utilizing different cements as well as sand and gravel produced from widely separated sources. Much valuable data has been accumulated since that time and different men working independently have perfected several new techniques to expedite the test procedure.

One significant contribution to the test procedure was recently made by Mr. Hime wherein the final cement determination was made on the basis of weight rather than by volume. The trial runs being performed in different localities showed that the same weights of different cements occupied unequal volumes when placed in the centrifuge tubes. This difference in volumes was found to be due to the unequal compressibility of these cements apparently caused by fineness of grind and other factors. To completely counteract these volumetric inequalities, Mr. Hime added one further step in his procedure. This additional step consisted of removing the sand which was floating in the top of the centrifuge tube, cleaning and drying it, and then determining its weight. This weight of sand subtracted from the original weight of the cement-sand mix in the tube gave the weight of the cement present. This approach appears to have many advantages not only from the standpoint of accuracy but also it reflects current practice of weighing the batch materials rather than using volumetric proportioning.

Results of several hundred tests performed over the last few years indicate that the cement content of a mixture can be determined by the Willis-Hime test to within ¼ sack per cubic yard. The test requires approximately 1½ hours to complete and may be performed in a field laboratory if the necessary equipment is available. If not, the sample may be transported to a testing laboratory. The testing work should begin within 1½ hours after the materials are added to the mixer to prevent partial hydration of the cement. The cost of the apparatus is about $250, about half of which is required for the electrical centrifuge. Many testing laboratories have most of the necessary equipment on hand and can supply any additional material for a very nominal investment.

The effect of admixtures on this cement determination was among one of the earlier questions raised. For the purpose of discussion, the admixtures currently being used in concrete fall into two primary classifications, organic and inorganic. The organic compounds are generally volatile or

burnable and the high temperatures used to dry the mix are sufficient to remove these compounds, thus eliminating their effect on the cement determination. The inorganic or mineral admixture compounds, however, present a problem since they cannot be easily removed and will be present in the final centrifuge samples. Most of these mineral additives are in the form of finely ground or powdered material many of which are classified as pozzolanic admixtures. Since these powdered materials are generally lighter in weight than the cement, but heavier than the sand, they can be made to float in the heavy liquid in a layer just below the sand. This separates the admixture from the cement and permits a volumetric determination of the amount of admixture if this information may also be desired.

In testing the Willis-Hime apparatus in the Los Angeles area, some difficulties were encountered with separating cement from small percentages of a black sand which is peculiar to many aggregate deposits in this locality. Being somewhat heavier than the cement, the black sand would settle to the bottom of the centrifuge tubes in a layer below the cement (see Fig. 4), and it could not be completely separated.

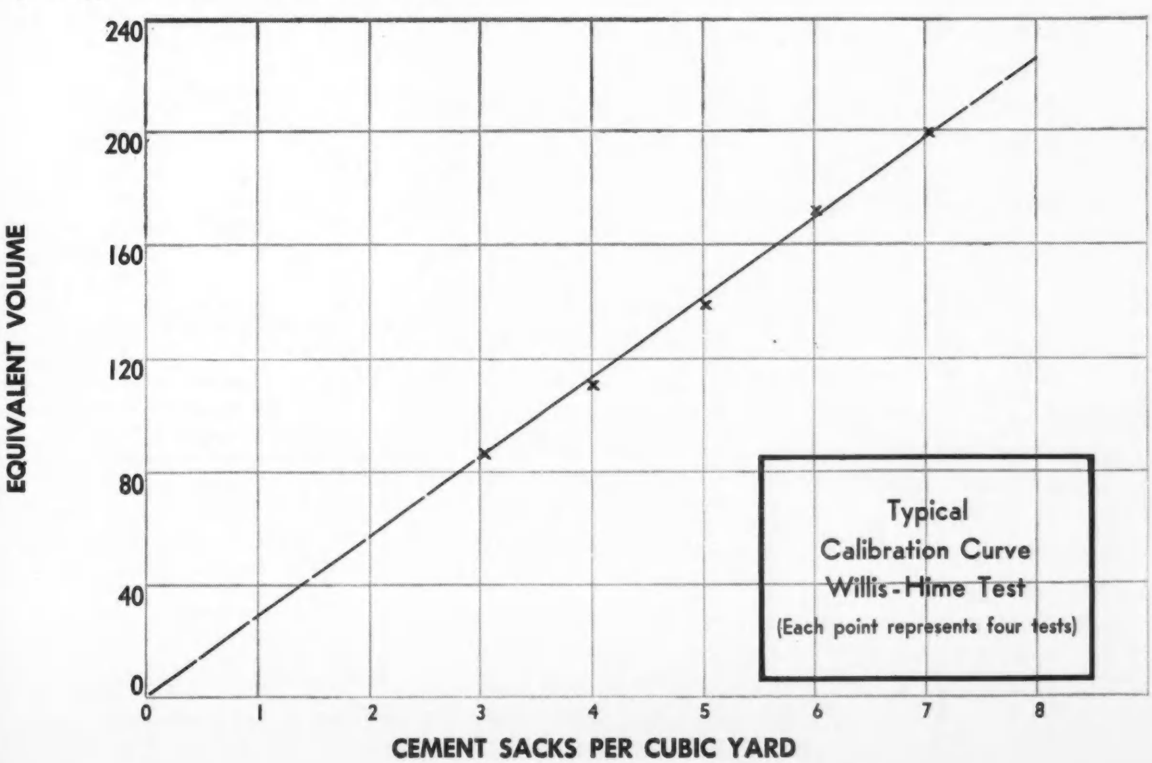
In solving this problem, a new and different approach was developed which might be successfully applied in any locality. This new idea for determining cement content is based upon a very simple principle which requires less equipment and is more adaptable to field usage. This method employs the principle of the specific gravities of the sand and of the cement, or the relationship of the weights of these materials to that of an equal volume of water.

The specific gravity of sand from any given source is easily determined and will have a value close to 2.65. Likewise, the specific gravity of any particular portland cement can also be easily obtained and will have a value close to 3.15. A combined mixture of sand and cement would have a specific gravity in between these two values, depending upon the percentage of the cement (see Fig. 5). By determining the specific gravity of an unknown mix, the percentage of cement can readily be found for a given set of conditions. If the percentage of cement is then known, the weight or sacks per cubic yard can be readily calculated.

The procedure for this latter test employs the same methods of washing and drying the material passing the 30 mesh screen as used in the Willis-Hime test. The specific gravities are then determined by measuring the volume of kerosene displaced by known weights of the materials in a glass flask with a graduated neck. Kerosene is used since it does not react with the cement and is readily obtainable. No heavy liquid is used and the centrifuge is no longer necessary. This entire operation could be easily performed on the job.

The fundamental ideas underlining this specific gravity testing method were developed just a few months ago. Time has not permitted a full scope of tests, but sufficient tests have been conducted to definitely establish the validity of the method. Obviously, additional tests are necessary to completely verify its general application. Even though the problem of black

**Fig. 3**—Typical calibration curve for Willis-Hime Test.



sand is minimized in this test, other questions with regard to mineral powdered admixtures yet remain to be solved. The accuracy of cement determination as indicated by results to date show a favorable comparison to the Willis-Hime test to within ¼ sack per cubic yard.

Going hand in hand with any cement determination test should be a method of quickly and accurately obtaining the total water content. This could be done by drying the original sample, but an even faster method would be desirable. Slump and workability tests are fast but their accuracy is often questioned. The biggest single problem is not in the cement content but rather in the exact control of total water content. A knowledge of both factors, though, makes it possible to accurately predict the future quality of the hardened concrete.

The Willis-Hime test is at present receiving consideration as a possible Recommended Practice by the American Society for Testing Materials. END

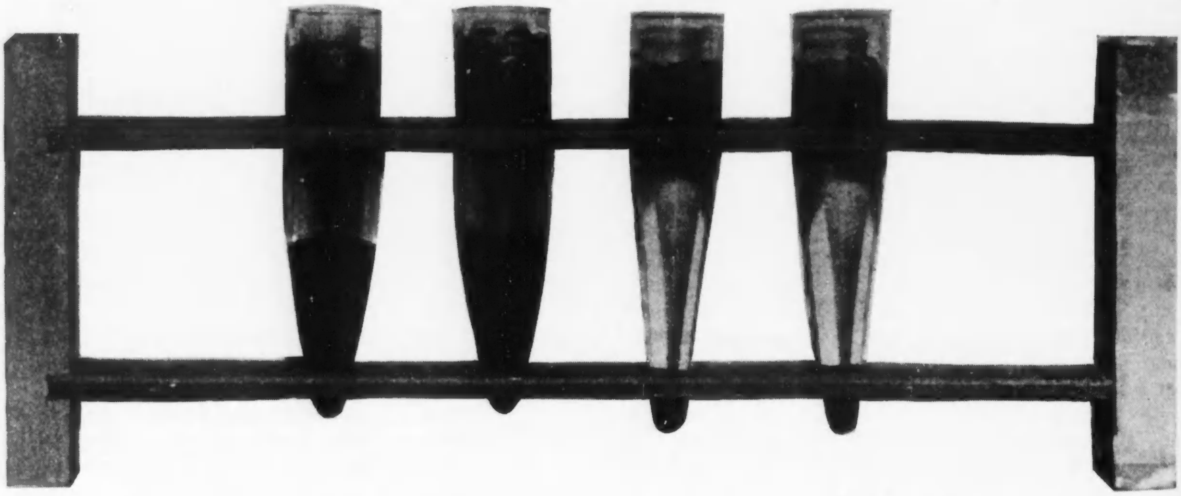


**Fig. 4**—Tapered centrifuge tubes on left showing layer of cement settled below sand. Right hand tubes show sample of sand only with small amount of heavy black sand in bottom.

**Fig. 5**—Typical calibration curve for specific gravity method.